

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A semiconductor device comprising:

an organic insulating film having an opening,

wherein said organic insulating film has a plurality of modified ~~portion~~portions facing said opening, and

said modified ~~portion~~portions includes nitrogen atoms.

2. (currently amended): The semiconductor device according to claim 1, wherein said modified portion further comprises fluorine atoms, and

a concentration of said fluorine atoms in said modified ~~portion~~portions is lower than a concentration of said nitrogen atoms.

3. (original): The semiconductor device according to claim 2, further comprising:

a metal conductor whose main component is copper, formed in said opening.

4. (currently amended): The semiconductor device according to claim 3, wherein said metal conductor is in direct contact with said modified ~~portion~~portions.

5. (withdrawn): A manufacturing method of a semiconductor device, comprising:

(a) forming an organic insulating film on a top surface side of a substrate;

(b) etching said organic insulating film to form an opening; and

(c) forming a modified portion including nitrogen atoms in a portion of said organic insulating film facing said opening.

6. (withdrawn): The manufacturing method of the semiconductor device according to claim 5, wherein said modified portion further comprises fluorine atoms, and a concentration of said fluorine atoms is lower than a concentration of said nitrogen atoms.

7. (withdrawn): The manufacturing method of the semiconductor device according to claim 6, wherein said (b) etching said organic insulating film comprises: etching said organic insulating film by using an etching gas containing a nitrogen gas and a fluoro-carbon, and said (b) step and said (c) step are carried out at a same time.

8. (withdrawn): The manufacturing method of the semiconductor device according to claim 7, wherein a molar ratio of said nitrogen gas is 50% or more of said entire etching gas.

9. (withdrawn): The manufacturing method of the semiconductor device according to claim 8, wherein a molar ratio of said nitrogen gas is 70% or more of said entire etching gas.

10. (withdrawn): The manufacturing method of the semiconductor device according to claim 7, wherein generation and stop of the generation of a plasma for said etching are alternately executed in said (b) etching said organic insulating film.

11. (withdrawn): The manufacturing method of the semiconductor device according to claim 7, wherein while said (b) step is executed, application and stop of the application of a bias to said substrate are alternately executed.

12. (withdrawn): The manufacturing method of the semiconductor device according to claim 5, wherein said (c) step is executed by exposing said portion of said organic insulating film facing said opening to a plasma containing said nitrogen atoms.

13. (withdrawn): A manufacturing method of a semiconductor device, comprising:

(d) forming an organic insulating film on a top surface side of a substrate; and

(e) etching said organic insulating film through a plasma containing nitrogen atoms to form an opening,

wherein at said (e) step, generation and stop of the generation of said plasma are alternately executed.

14. (withdrawn): A manufacturing method of a semiconductor device, comprising:

(d) forming an organic insulating film on a top surface side of a substrate; and

(e) etching said organic insulating film through a plasma containing nitrogen atoms to form an opening,

wherein while said (e) step is executed, application and stop of the application of a bias to said substrate are alternately executed.

15. (withdrawn): A manufacturing method of a semiconductor device, comprising:

(f) forming an organic insulating film;

(g) etching said organic insulating film to form an opening; and
(h) exposing said organic insulating film to a plasma containing nitrogen atoms, after forming said opening.

16. (withdrawn): A manufacturing method of a semiconductor device, comprising:

(i) forming a first interlayer insulating film formed of an organic compound;
(j) forming a second interlayer insulating film formed of an organic compound, on a top surface side of said first interlayer insulating film;
(k) forming a wiring groove penetrating said second interlayer insulating film and a via-hole penetrating said first interlayer insulating film, through one etching process;
(l) forming modified portions containing nitrogen atoms, on a sidewall of said wiring groove and a sidewall of said via-hole; and
(m) embedding said wiring groove and said via-hole with conductors, after said (l) step.

17. (withdrawn): The manufacturing method of the semiconductor device according to claim 16, wherein said modified portion further comprises fluorine atoms, and

a concentration of said fluorine atoms is lower than a concentration of said nitrogen atoms.

18. (withdrawn): The manufacturing method of the semiconductor device according to claim 17, wherein in etching said wiring groove and said via-hole, an etching gas containing nitrogen atoms and fluoro-carbon are used and said (l) step is executed simultaneously with said (k) step.

19. (new): The semiconductor device according to claim 4, wherein the metal conductor comprises a barrier film whose main component is tantalum.

20. (new): The semiconductor device according to claim 19, wherein the barrier film is in direct contact with the modified portions.